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(19)

(54) IMPROVEMENTS IN OR RELATING TO MEDICAL FACE MASKS

(71) We, VICKERS LIMITED, a British Company, of Vickers House, Millbank Tower, Millbank, London, S.W.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to medical face masks.

According to the present invention there is provided a medical face mask comprising a hollow body portion that can be placed over the nose and mouth of a patient, and an inlet portion communicating with the interior of the hollow body portion and including a gas injector and air inlet means positioned to permit air to be drawn into the mask by the effect of the negative pressure produced within the inlet portion by the injection of gas thereinto through said gas injector, there being outlet means in the hollow body portion to permit air exhaled by a patient to leave the mask; the air inlet means being adjustable to enable selection of the amount of air drawn into the mask at any particular flow rate of gas through the injector.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Figure 1 is a front perspective view of a medical face mask,

Figure 2 is a side view of the mask of Figure 1 illustrating the various gas-flows that occur in use, and

Figures 3 and 4 are front views of details of the mask of Figures 1 and 2.

The mask of the Figures has a hollow body portion 1 formed of a translucent pliable plastics material. The body portion 1 is of appropriate configuration to be fittable to a patient's face so as to contain the nose and mouth, the mask being fitted to the patient utilising an elastic cord secured to holes 2 in lugs 3 extending from the rim portion 4 of the body portion 1, this rim portion 4 extending laterally of the remainder of the body portion 1 to facilitate close fitting of the mask to the patient's face.

An inlet portion 5 of the mask is formed by a rigid tube 6 that extends from the body portion 1. A disk 7 is fast in the tube 6 at its free end, that is at its end remote from the body portion 1. An inlet jet 8 rigid with the disk 7 extends through the centre of the disk 7. A further disk 9 is rotatably mounted on the jet 8 outside the tube 6, this disk 9 being urged into face to face contact with the disk 7 by a compression spring 10 mounted on the jet 8 and acting between the disk 9 and a shoulder 11 on the jet 8.

The outer end of the jet 8 is formed for having connected to it a gas supply pipe, the jet constituting an injector and the two co-operating disks 7 and 9 constituting air inlet means positioned to permit air to be drawn into the mask by the effect of the negative pressure that is produced at the free end of the interior of the tube 6 when gas is injected into the tube through the jet 8. To this end, and referring to Figures 3 and 4, the disks 7 and 9 are apertured. The disk 7 has four apertures A, B, C and D, disposed on the same pitch circle diameter but of different individual diameters. In the illustrated example shown the diameters are A = 0.1470", B = 0.2130", C = 0.2130" and D = 0.28125" spaced at 60° apart on a pitch circle diameter of $\frac{3}{4}$". The disk 9 has four corresponding apertures *a*, *b*, *c* and *d* which, in one position of the disk 9 relative to the disk 7, align with the apertures A, B, C and D respectively. To ensure that air flow through the apertures that are in line

with one another is, in most positions of the disk 9 relative to the disk 7, determined by the sizes of the apertures A, B, C and D, the apertures *b*, *c* and *d* are each of slightly larger diameter than the corresponding apertures B, C or D. In the illustrated example *a* = 0.1285", *b* = 0.234375", *c* = 0.28125" and *d* = 0.34375" in diameter.

In addition to the apertures A, B, C and D the disk 7 is provided with a pip 12 directed towards the disk 9 and disposed on the same pitch circle diameter as the apertures A, B, C and D for engagement with either one of two closed bores 13, 14 in the disk 9 on the same pitch circle diameter as the apertures *a*, *b*, *c* and *d* and equi-angularly spaced apart therefrom and from each other. In the illustrated example the pip 12 is 0.125" in diameter and the bores 13, 14 are each 0.134" in diameter. The pip 12 can alternatively be engaged in the aperture *a* or in the aperture *b* as discussed below.

The mask is used as follows. The particular example illustrated is intended to have its jet 8 connected to an oxygen source supplying oxygen at a flow rate within the range of 8 to 14 litres per minute, and to operate within acceptable limits up to a flow rate of 19 litres per minute. Oxygen entering the mask through the jet 8 (dotted lines 15 in Figure 2) causes air to be drawn in through whichever of the apertures in the two disks 7 and 9 are in alignment (chain dot lines 16). The thus oxygen-enriched air enters the mask body portion 1 to be inhaled by the patient. The length and inner diameter of the tube 6, and the diameter of the orifice of the jet 8, are such that the jet of oxygen entering the tube 6 breaks up within the tube 6 before entering the body portion 1 and the resultant turbulent gas-flows within the tube 6 (illustrated in Figure 2) prevent oxygen not inhaled by the patient, and exhaled air, re-entering the tube 6. The excess oxygen and exhaled air is permitted to leave the mask through apertures 17 in the mask body 1 (chain lines 18). In this illustrated example the tube 6 is $3\frac{7}{8}$" long, its inner diameter is 1", and the jet orifice is 0.144" in diameter.

The desired oxygen concentration in the gas stream entering the mask body portion 1 is selected by adjusting the position of the disk 9 relative to the disk 7, percentage concentrations of 50%, 60%, 70% and 80%, within ± 1%, at oxygen flow rates of from 8 litres per minute to 14 litres per minute being obtainable with the illustrated mask by setting the disk 9 as follows:—

Pip 12 engaged in bore 13, apertures *a*, *b*, *c* and *d* respectively aligned with apertures A, B, C and D—50% oxygen concentration.

Pip 12 engaged in bore 14, apertures *b*, *c* and *d* respectively aligned with apertures A, B and C, apertures *a* and D blanked off—60% oxygen concentration.

Pip 12 engaged in aperture *a* (blanking this aperture off), apertures *c* and *d* aligned with apertures A and B, apertures *b*, C and D also blanked off—70% oxygen concentration.

Pip 12 engaged in aperture *b* (blanked off), apertures *a* and *d* aligned with apertures D and A, apertures *c*, B and C also blanked off—80% oxygen concentration.

In the last position (80% oxygen concentration), although the pip 12 is a very loose fit in the aperture *b*, the relative sizes of the apertures *a* and D and *d* and A are such that the apertures A and *a* are always open throughout the range of movement permitted to the disk 9 in this position.

It will be appreciated that the various settings described above are obtained by positive location of the pip 12 in either the bore 13, the bore 14, the aperture *a* or the aperture *b*, the setting being altered by withdrawing the disk 9 against the action of the spring 10, rotating the disk 9 and releasing it again. Appropriate scale markings carried by the disk 9 line up with a fiducial line on the disk 7 for each of these settings.

WHAT WE CLAIM IS:

1. A medical face mask comprising a hollow body portion that can be placed over the nose and mouth of a patient, and an inlet portion communicating with the interior of the hollow body portion and including a gas injector and air inlet means positioned to permit air to be drawn into the mask by the effect of the negative pressure produced within the inlet portion by the injection of gas thereinto through said gas injector, there being outlet means in the hollow body portion to permit air exhaled by a patient to leave the mask; the air inlet means being adjustable to enable selection of the amount of air drawn into the mask at any particular flow rate of gas through the injector.

2. A medical face mask as claimed in Claim 1, wherein said air inlet means comprises a pair of relatively movable apertured members, the arrangement being such that said selection of the amount of air drawn into the mask can be effected by aligning particular apertures of the pair of members.

3. A medical face mask as claimed in Claim 2, wherein a first of the apertured members is rotatable relative to the second apertured member and each has a plurality of apertures, the apertures in each member being disposed on a common pitch circle

and the pitch circles of the apertures in the two members being of the same radius and coaxial about the axis of rotation of the rotatable member.

4. A medical face mask as claimed in Claim 3, wherein resilient means is provided for urging the pair of apertured members into face to face contact.

5. A medical face mask as claimed in Claim 4, wherein that face of one of the pair of apertured members that contacts a face of the other member is provided with a protrusion that rides over the last-mentioned face during relative rotation of the two members with the members separating against the opposition of the resilient means, this protrusion being disposed for engaging selected one of the apertures in this other member to locate the relative positions of the two members and permit the resilient means to re-assert itself to bring about said face to face contact.

6. A medical face mask as claimed in Claim 3, 4 or 5, wherein said second apertured member is fast with said inlet portion, wherein said gas injector is an inlet jet mounted fast on the second apertured member, and wherein said first apertured member is rotatably mounted on this inlet jet.

7. A medical face mask substantially as hereinbefore described with reference to the accompanying drawings.

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2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

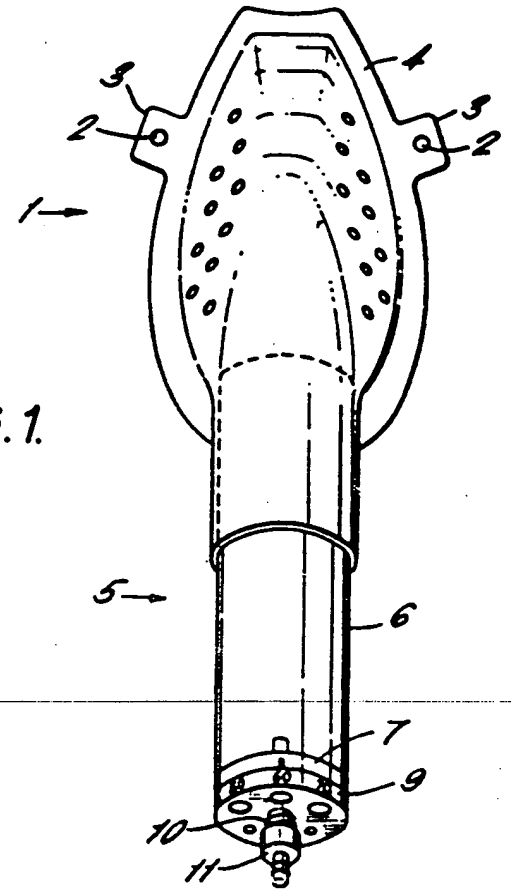

FIG. 1.

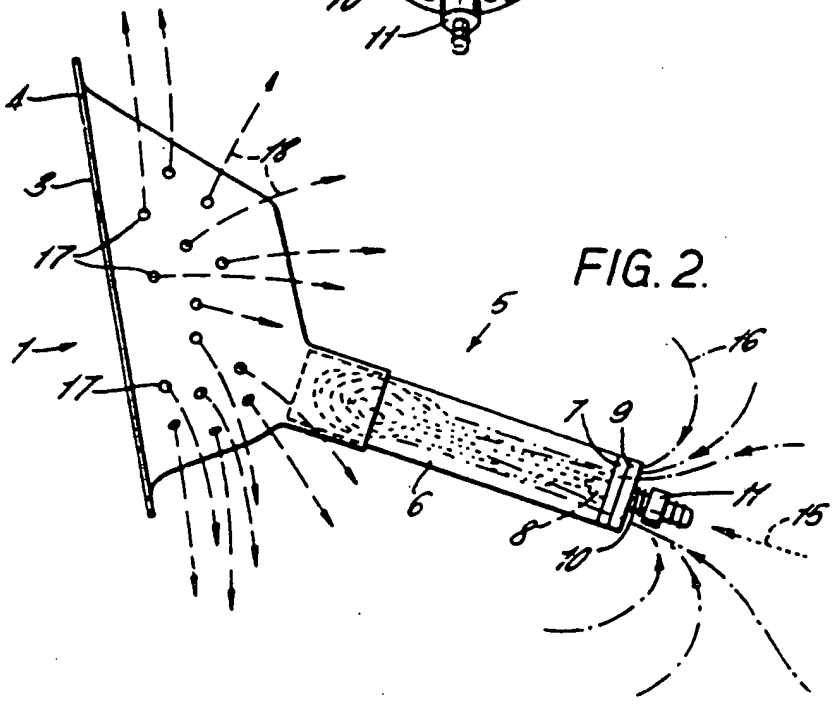

FIG. 2.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

FIG. 3.

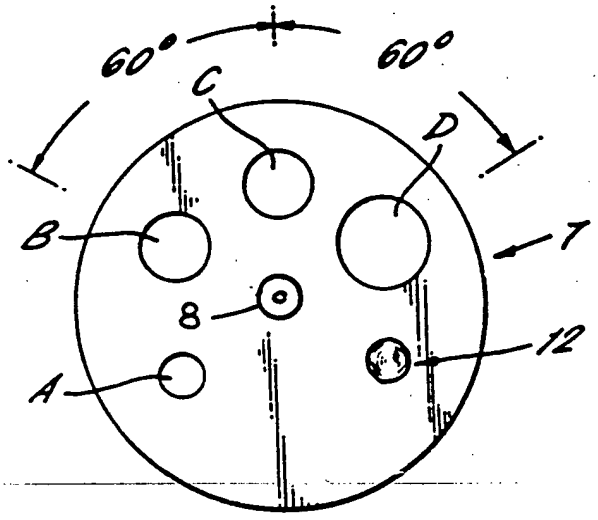
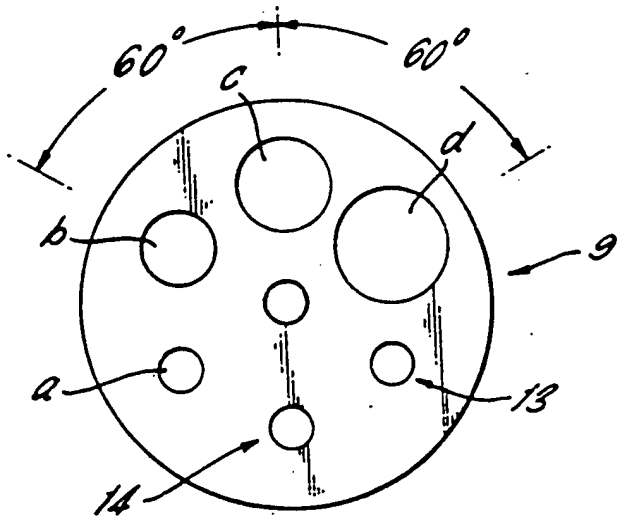


FIG. 4.



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SHEET 2

FIG. 3.

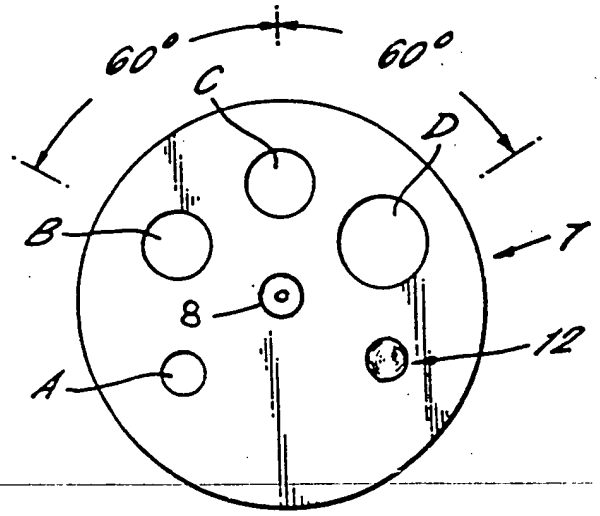

FIG. 4.